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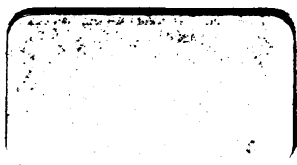


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MEMOIRS OF THE GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE GEOLOGY OF
THE COUNTRY AROUND
BOURNEMOUTH.

(EXPLANATION OF SHEET 329.)

BY

CLEMENT REID, F.L.S., F.G.S.

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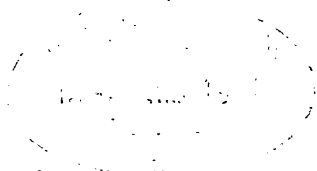
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PREFACE.

THE Hampshire cliffs between Christchurch and Lymington long ago attracted attention for the number and beauty of their fossil shells. They were described by Gustavus Brander, in his "*Fossilia Hantoniensia*" published in 1766, with descriptions of the fossil shells by Dr. Solander, and beautiful plates of the species of which no less than ten are reproduced in the following explanation.

In later years original researches among the same strata were carried on by Lyell, Prestwich, the Rev. Osmond Fisher and others, of whose labours further account will be given in a forthcoming general memoir on the Hampshire Basin. Especial mention, however, should be made here of the detailed observations of Mr. J. Starkie Gardner, which are further referred to in the following pages.

The area comprised within the map (Sheet 329, new series) of which the present pamphlet is explanatory, was originally surveyed by the late H. W. Bristow and J. Trimmer, and was included in Sheets 15 and 16 (original series) of the Geological Survey Map of England, published in the years 1855-56. In this map the superficial deposits were not represented. During the revision of the Geological Survey of the South of England, the district here described has been re-examined by Mr. Clement Reid, who in 1892-4 mapped it on the scale of six inches to one mile, and traced the distribution of all its superficial deposits. Two editions of the map here described are issued, one showing the areas occupied by the Cretaceous, Eocene, and Oligocene strata ("*Solid Geology*" edition), the other displaying the distribution of the various surface deposits ("*Drift*" edition).

The present explanation has been prepared by Mr. Reid. It is intended as a general guide to the use of the map until a more detailed account of the whole surrounding region can be issued. Thanks are due to Mr. Gardner, and to the Council of the Geological Society, for permission to use two illustrations from his valuable papers.

The map embraces a considerable part of the Tertiary basin of Hampshire. Till it came into vogue as a residential district, much of this part of the country was almost uninhabited, and the towns, though ancient, were very small. Bournemouth has entirely sprung into existence within recent years, the old Ordnance Map of 1811 showing on the site merely a single house and decoy ponds, in the midst of open moors.

ARCH. GEIKIE,

Director-General.

Geological Survey Office,
28, Jermyn-street, London, S.W.,
23rd May, 1898.

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THE GEOLOGY OF

THE COUNTRY AROUND

BOURNEMOUTH.

INTRODUCTION.

SHEET 329 of the Geological Survey Map takes in an area of 170 square miles in Dorset and Hampshire, including the coast from Christchurch Bay to Poole Harbour. The towns in the district are Bournemouth, Poole, Christchurch, and Wimborne. The land slopes to the south or south-east, corresponding in this with the course of the rivers Avon, Stour, and Frome. The Chalk Downs north-west of Wimborne reach a height of 327 feet within the area of this map, and nearly as great an elevation is attained by the outlier of Plateau Gravel and Headon Beds, which is found near its north-east corner. From these points there is a fall to the flat-topped cliffs, which usually range in height between 100 and 140 feet. In Poole Harbour and the Frome estuary tidal mud forms extensive flats bare at low water. The rivers Avon and Stour, on the other hand, exhibit broad tracts of freshwater Alluvium, flanked by a still wider belt of river gravel occupying a slightly higher level. The rest of the area stands well above the sea, and consists in the main of sandy and gravelly land of little agricultural value, but forming extensive open heaths, varied by scattered self-sown pine trees. Better land is found on the Chalk, Reading Beds and London Clay around Wimborne, though this only occupies a small portion of the ground under consideration.

The formations represented on Sheet 329 are the following :—

Recent -	{	Blown Sand.
		Alluvium.
		Peat.
Pleistocene -	{	Brickearth.
		Valley Gravel.
		Plateau Gravel.
Oligocene -	{	Headon Beds.
		Barton Sand.
		Barton Clay.
Eocene -	{	Bracklesham Beds.
		Bagshot Sand.
		London Clay.
		Reading Beds.
Cretaceous -	{	Upper Chalk.

The whole of the area is occupied by the southward slope of the main Hampshire Basin syncline, the rise towards Studland and the Isle of Purbeck commencing just outside the district. The inclination of the strata is never great, only occasionally approaching 2°, and usually about 1°. The synclinal trough has an almost flat bottom with but minor undulations. This flatten-

ing is due to the arrangement of the subordinate folds *en échelon*, the westward disappearance of one syncline near Wimborne coinciding with the increase of another fold which passes under Poole Harbour.

The strata which, in this area, are of greatest interest for their included fossils, their exceptional development, or the clearness of their exposure are these:—The Bagshot sands and associated leaf-bearing pipe-clays around Poole Harbour; the Bournemouth freshwater series, inseparable from the beds below except by their fossil plants; the marine Bracklesham Beds of Bournemouth cliff; the highly fossiliferous Barton Clay of Barton Cliff; and the Plateau Gravel, the lower edge of which has yielded many Palæolithic implements at Barton and Bournemouth. As it is obviously impossible fully to describe the geology of the district in the few pages of this Memoir, attention will be devoted mainly to those strata for which the district is particularly famed.

CHALK.

Though Chalk with flints occupies about eight square miles in the district north-west of Wimborne, only some 150 or 200 feet of it can be seen, and the whole of this probably belongs to the highest division, or zone of *Belemnitella mucronata*. This belemnite and *Echinocorys vulgaris* are not uncommon; but other fossils are not abundant, and all observed belong to wide spread Upper Chalk species.

READING BEDS.

These occupy some five square miles near Wimborne, and are principally remarkable for their extreme variability. Coarse sands give place to tough red-mottled clays, and within a short distance the whole 70 feet or so may change from clay to sand. The basement-bed is pebbly, or contains unworn green-coated chalk-flints. A pit in the small outlier west of Kingston Lacy Park shows:—

	Feet.
Lenticular ash-coloured loams, with a few flints at the base	5 to 9
False-bedded rough sand full of chips of flint. Scattered flint pebbles and unworn flints in the lower part	
	8

The position of this outlier is curious, and taken with the coarse, almost gravelly nature of the deposit, suggests that the Reading Beds here rest on Chalk unconformably—as do the Reading gravels a few miles further west. No fossils have been found in deposits of this age in Dorset.

LONDON CLAY.

The London Clay rises to the surface near Wimborne, but is not well exposed. Its thickness of about 100 feet is chiefly made up of bluish loamy clay, alternating with loamy sands and thin ironstones. Towards the base it is usually sandy, and more or

less full of flint pebbles. The only fossils I have seen from this area are fragments of lignite, and an indeterminable bivalve found in a well-boring at Wimborne.

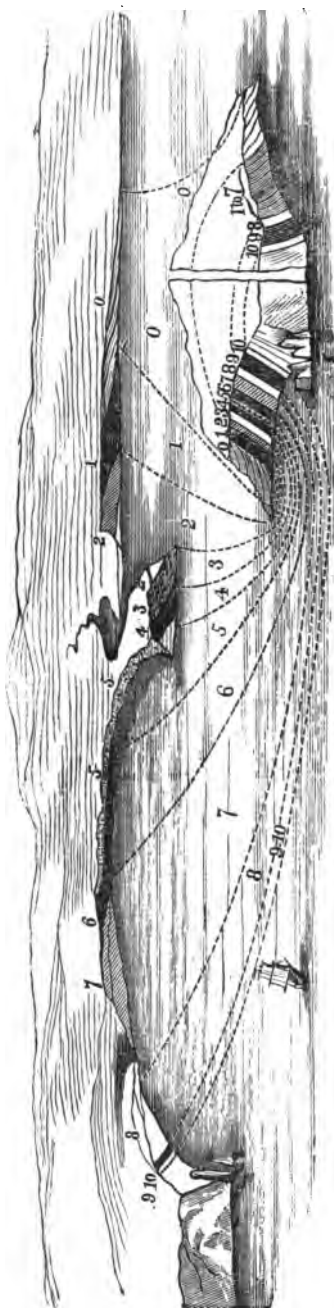
BAGSHOT SANDS.

On the London Clay rest several hundred feet of sand, interbedded in which are numerous lenticular masses of carbonaceous loam or clay containing fossil leaves. The white pipe-clay, so extensively worked round Poole Harbour and in districts further west, occurs about 200 or 250 feet above the London Clay. These strata are in the main of fluvial origin; but in the deposits above the pipe-clay one often meets with *Teredo*-bored wood, or even with casts of marine shells or polyzoa. The mixture of marine with freshwater fossils makes classification very difficult; for there appears to be an upward passage into the marine Bracklesham Beds, and the upper half of this mass of sand—the “Bournemouth Beds” of Mr. Starkie Gardner—is probably equivalent to the lower part of the marine Bracklesham series further east. Mr. Gardner has been so good as to lend Fig. 1, (see next page) which shows the equivalents in the Isle of Wight. It is impossible, however, to compare land plants with marine animals, and the only practicable division on the map seems to be into a lower sandy division, essentially fluvial, forming the Bagshot Sands, and a higher, more loamy, marine Bracklesham Series. In the lower division we can recognise the two zones separated by Mr. Gardner, on the ground of the marked difference between the flora of the pipe-clay beds and that of the Bournemouth Beds above; but it is impossible to separate them inland, especially on the northern outcrop, where the pipe-clay has disappeared.

The lower division consists mainly of a mass of coarse false-bedded quartz-sand, apparently derived from the decomposition of granite. Near the top occurs a bed, 20 feet or more in thickness, of white or red-mottled pipe-clay, extensively dug for the manufacture of earthenware, and used in the local potteries, or shipped from Poole Harbour. The sands sometimes show the peculiar and unusual colours so noticeable in the same strata in Alum Bay; but they are not otherwise of great interest. They here yield no fossils, having been thoroughly decalcified and oxidised by the action of percolating water—or rather, this is the case in the visible part, for borings beneath the water-level show that there the sands are bluish and full of pyrites.

The pipe-clay has been extensively dug, sometimes in workings open to the day, but as often in mines. The workable pipe-clay seems to be confined to the south-western part of the Hampshire Basin, for the most northerly place where it has been dug is at Beacon Hill, near Lychett; there, however, the mines are now abandoned. In the Bourne Valley, half a mile above Bournemouth Gas Works, clay is now worked in an open pit to a depth of over 20 feet. The wetness of this and of the adjoining valleys is probably due to the presence of the impervious pipe-clay within a

FIG. 1.—Ideal View of the Isle of Wight and the adjacent Land, with dotted lines connecting the nearly horizontal beds of the Mainland with the vertical beds of the Island. (J. S. GARDNER.) (Reproduced, by permission, from the *Quart. Journ. Geol. Soc.*, Vol. xxxv. (1879), p. 212.)



- | | | |
|---|---|-----------------------------------|
| 0. Oligocene. | 3. Upper Hengistbury-Head beds, with ironstone. | 6. Bournemouth Marine Series. |
| 1. Barton Beds. | 4. Lower Hengistbury beds, with green grains. | 7. Bournemouth Freshwater Series. |
| 2. Upper Bracklesham and Higheliff white-sand beds. | 5. Boscombe Sands. | 8. Lower Bagshot. |
| | | 9. London Clay. |
| | | 10. Woolwich and Reading beds. |

few feet of their bottoms. Other clay-pits are now being worked to the north and south of Parkstone, near Hamworthy Junction, and at Lake Clay Works; and pipe-clay was formerly mined beneath the sea-level under Brownsea Island. South of Poole Harbour clay is seen at various places near the water's edge, and is well exposed in open pits at Newton Clay Works, just south of the area here described. The clay is apparently derived from the decomposition of the felspar of a granitic area, like that of Dartmoor.

Though fossil leaves occur abundantly in the pipe-clay at Studland, Corfe Castle, and Alum Bay, comparatively few have been found within the limits of the Bournemouth Map, and those from the old pits in Brownsea Island unfortunately were not preserved. The general character of the vegetation of this period found at Alum Bay has been well described by Mr. J. Starkie Gardner.* The few fragments from the Bournemouth area belong to palm and other sub-tropical plants; at Alum Bay the abundance of leguminous plants, and of leaves ascribed to figs and laurels, forms a marked characteristic of the flora of the period.

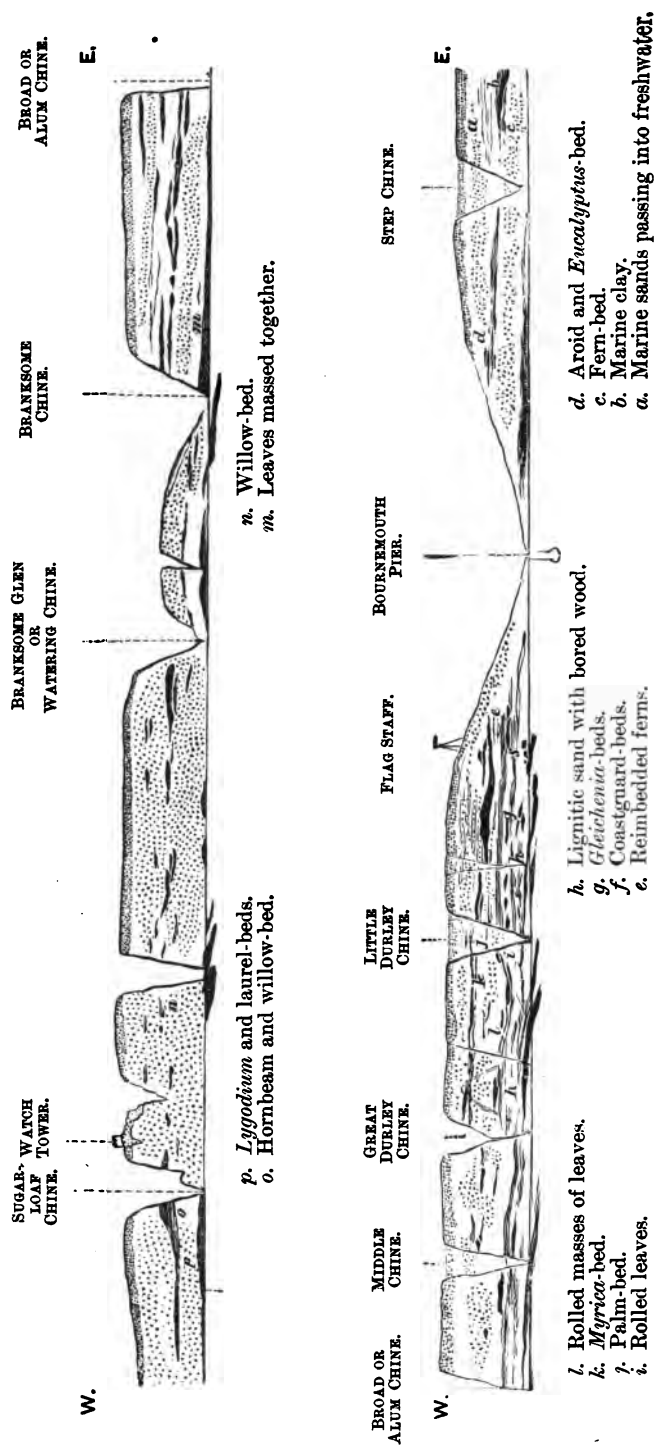
The higher division, or Bournemouth Freshwater Series, though covering a large area, can only be studied properly in the Bournemouth cliffs. It consists of strongly current-bedded yellow or whitish sands, with many lenticular masses of clay or loam containing lignite (often bored by *Teredo*), and leaves of plants, usually unlike those of the lower division, and differing greatly in the different masses. As our knowledge of these beds is chiefly due to the careful researches of Mr. Gardner, the accompanying illustration (Fig. 2) is borrowed with his permission and that of the Geological Society. The details of these fast-changing strata are so complicated that here space will only allow the merest outline to be given, and for fuller accounts of the plant-beds, readers must be referred to Mr. Gardner's paper.†

The structure of the beds, the impersistent character of the clays, and the nature of the enclosed fossils, all suggest that this series was deposited by a river flowing from the west, and bringing with it sand, grit, and carbonaceous mud. As the channels shifted, back-waters were formed in which clays were tranquilly deposited, and leaves were imbedded uninjured; as the land subsided the total mass of sand and clay became thicker and thicker, till the depth of the fluviatile strata between the London Clay and the Bracklesham Beds amounted to about 700 feet. The general dip is south-easterly, and the oldest deposits are found near Poole Harbour; but in all probability 100 feet of strata between the pipe-clay and the lowest beds at Poole Head are hidden. Whether these missing strata are more nearly allied to the pipe-clay series below, or to the Bournemouth freshwater

* In the "Geology of the Isle of Wight," 2nd edition. *Memoirs of the Geological Survey*, pp. 104-108. 1889.

† "Description and Correlation of the Bournemouth Beds. Part II. Lower or Freshwater Series." *Quart. Journ. Geol. Soc.*, vol. xxxviii., pp. 1-15. 1882. 1005.

FIG. 2.—View of Cliffs between Poole Harbour and Boscombe, showing position of Plant-beds, &c. (J. S. GARDNER.)
(Scale: 5 inches to 1 mile horizontal. Vertical scale exaggerated.) (Reproduced, by permission, from the
Quart. Journ. Geol. Soc., Vol. xxxviii. (1882), p. 4.)



series above, cannot be said, for the inland sections have as yet yielded only obscure traces of plants. Between Poole Harbour and Canford Cliff Chine several plant-beds occur, each containing different species, amongst others Mr. Gardner mentions a compound *Acacia*-like leaf, a *Smilax* with thin twining stem, *Lygodium*, laurels, and also a fossil feather. The section between Canford Cliff Chine and Watering Chine is characterised by abundance of palms and ferns. The eastern section, from Watering Chine to the Bourne Valley, contains net-veined ferns, *Araucaria*, and *Eucalyptus*. A full account of these interesting plant-beds will ultimately be published in the monographs of the Palæontographical Society, but unfortunately only the parts on ferns and conifers have yet appeared, and the bulk of the species remain still to be described.

BRACKLESHAM BEDS.

Next comes a series of sands and loams mainly of marine or estuarine origin. These are equivalent to the Bracklesham Beds, so well shown and so full of fossils in the Selsey Peninsula; * but as the fossils in the Bournemouth cliffs are badly preserved and difficult to extract, only a short account of them need here be given. This is taken in the main from a paper by Mr. Gardner,† who was the first to work out in detail the succession of the deposits in these cliffs. The marine deposits first appear in the cliff above the Bath Hotel; but their westerly termination is very peculiar, for they seem to pass into freshwater deposits both horizontally and vertically. A short distance from Steps Chine the beds show very well the passage from marine to brackish and freshwater conditions, the section being as follows:—

Dark sands with green grains, containing *Ostrea dorsata*? (coated with *Flustra*), *Arca appendiculata*? *Modiola*, *Tellina tenuistriata*, *Calyptræa trochiformis*? *Xenophora* (*Phorus*) *agglutinans*, *Natica labellata*, *Cerithium*.

Liver-coloured clay (turning black on exposure), with abundant remains of *Callianassa* and *Bryozoa*. 15 feet.

[The surface of the bed beneath is eroded for about 6 inches, and filled in with the overlying clay.]

Stiff black clays passing into lighter liver-clays at bottom, and, after a break, into liver-clay with ferns. Very dark sandy clay. White or ash-coloured sand with lignitic bands. 30 feet.

The fossils, though badly preserved, are sufficient to prove the Bracklesham age of the deposits.

A few yards further east irregular masses of shingle occur in still newer beds, brought in by the eastward dip. The pebbles are perfectly rounded, and consist almost entirely of Chalk flint, with a few quartzites like those of Budleigh Salterton. Then

* "The Geology of the country around Bognor" (Sheet 332), *Memoirs of the Geol. Survey*. 1897.

† "Description and Correlation of the Bournemouth Beds.—Part I. Upper Marine Series." *Quart. Journ. Geol. Soc.* Vol. xxxv., p. 209. 1879. 1005.

follow, about a mile east of Bournemouth, loams with drifted fruits of the *Nipa*-palm, *Hightea*, and *Anona*, and *Teredo*-bored logs of wood. On the west side of Boscombe Chine there is green-sand with oysters and *Bryozoa*. Honeycomb Chine is noticeable for the occurrence there of a thin bed full of fruits of *Nipa*, and about 120 yards to the east is a sand containing perfect limbs of an American form of *Cactus*, described by Heer from Bovey Tracey as *Palmarites demonorops*. Similar alternations of fluvatile and estuarine beds continue to Hengistbury Head, which is remarkable for its large tabular masses of ironstone, once extensively worked; these contain *Teredo*-bored wood, and teeth of sharks. The Highcliff Sands above yield few fossils, and are greatly hidden by newer deposits, and eastward by slips of Barton Clay.

BARTON CLAY.

This division consists of a mass of grey more or less sandy clay, reaching a thickness of about 110 feet, and passing almost imperceptibly into the Bracklesham series below, and into the Barton Sands above. The deposits are well shown in the cliffs between Highcliff and Barton, except where hidden by landslips. They contain a fauna more prolific than that of any stratum of like thickness in Britain. The fossils are usually in a perfect state of preservation, and are almost entirely of marine origin; many of them, especially of the volutes, are confined to particular zones.* The lowest bed is a green sandy clay, with a layer of flint-pebbles at its base. Lithologically this seems more allied to the clay above than to the Bracklesham series below, and the pebble-bed forms a recognisable base. The fossils are, however, insufficient to settle the question, and Messrs. Gardner, Keeping, and Monckton prefer to draw the boundary 10 feet higher, at the point where *Nummulites elegans* first appears. The next division is of similar lithological character; but contains at its base a seam containing *Nummulites*. The marine mollusca mostly range downwards into the Bracklesham Beds, and upwards into the true Barton Clay; but mixed with them are drift-wood and fir-cones. These clays pass upwards into the Highcliff Sand, noticeable for its local accumulations of small perfectly preserved shells. Next follows the Barton Clay proper, with its numerous shells of subtropical aspect, of which a few are figured on the opposite page. Tropical fishes, such as *Arius*, and sharks, mostly belonging to the genera *Lamna* and *Odontaspis*, are also common. Land animals are unknown in these deposits.

BARTON SANDS.

Continuing the upward succession in Barton Cliff, one finds the clay gradually becoming very sandy and crowded with shells of *Chama*. These *Chama*-beds are about 15 feet thick, and pass

* For further particulars see Gardner, Keeping, and Monckton, "The Upper Eocene, comprising the Barton and Upper Bagshot Formations." *Quart. Journ. Geol. Soc.*, Vol. xliv., pp. 578-635. 1888.

FOSSILS OF THE BARTON CLAY.

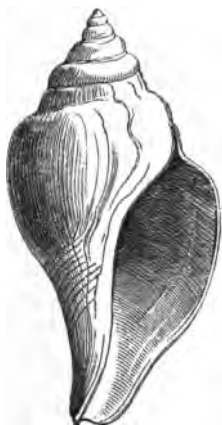


Fig. 3.
Fusus pyrus, Sol.

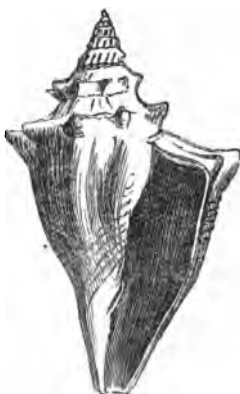


Fig. 4.
Voluta luctatrix, Sol.



Fig. 5.
Fusus longevus, Sol.



Fig. 6.
Murex asper, Sol.



Fig. 7.
Xenophora agglutinans, Lam.



Fig. 8.
Rimella rimosa, Sol.



Fig. 9.
Conorbis dormitor, Sol.

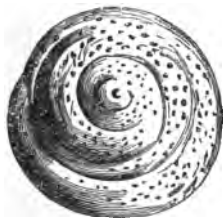


Fig. 10.
Calyptraea aperta, Sol.



Fig. 11.
Typhis pungens, Sol.

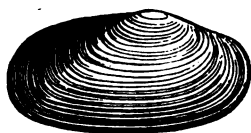


Fig. 12.
Psammotæa compressa, Sow.

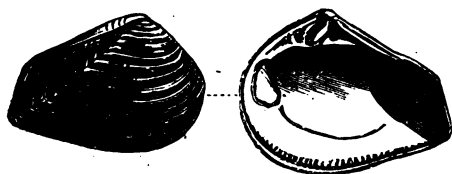


Fig. 13.
Crassatella sulcata, Sol.

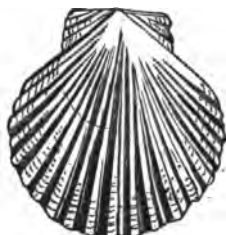


Fig. 14.
Pecten reconditus, Sol.

into white, very fine, unfossiliferous sand, 25 feet thick on the coast. Next come the "Becton Bunny Beds"—black loamy hard sands full of marine fossils, of which *Oliva Branderi* is one of the most abundant. These are also about 25 feet in thickness, and are followed by dust-like white and yellow sands, unfossiliferous in the lower 15 feet, but passing gradually into the Long Mead End Bed, a mass of shelly sand, varying in colour, and about five feet thick. This deposit contains an interesting fauna, unfortunately only partially worked out, as the shells are very fragile. It is apparently a transition bed to the freshwater Headon Beds above; for mingled with marine shells like those of the Barton Clay, and a few of peculiar species, there occur in profusion several species of *Cyrena*. A species of *Cerithium*, apparently *C. pleurotomides*, is one of the commonest fossils; it must not be confounded with the allied *C. concavum* of the Middle Headon Beds. The fossiliferous Long Mead End Bed can only be seen east of the limits of this map, for none of the inland sections contain shells. The total thickness of the Barton Sands is about 90 feet.

HEADON BEDS.

Within the area here described there are few good sections of the estuarine and freshwater Lower Headon series, which apparently consists of green and red marls and marly sands. At Thorny Hill green clay yields *Cyrena* and *Potamomya*, while half a mile further north is a pit in green and red marl containing oysters mixed with estuarine shells, such as *Melania* and *Melanopsis*. This division can be studied to more advantage in Hordle Cliff and in the Isle of Wight.

PLATEAU GRAVELS.

The flat-topped Tertiary hills are everywhere covered by partially rolled gravel, sloping southward or south-eastward towards the sea. This gravel divides itself into two sheets, the older of which is separated by a sharper slope from the newer, though the two cannot always be separated on the map, and are therefore coloured alike. The higher gravel ranges from 150 to 300 feet within this area; but reaches much greater elevations further from the sea. It is composed of flint, with a considerable admixture of Greensand chert and various Palæozoic rocks, all apparently derived from gravelly Bagshot and Reading strata near Dorchester, and not direct from Devon. This gravel has yielded no fossils, and, as yet, no trace of man, though Palæolithic implements occasionally occur in the soil above.

The newer Plateau Gravel usually caps the cliffs, and covers a plain sloping gently upward to the degraded cliff or bluff at 150 feet. Passing into the valleys of the Avon, Stour, and Frome, it gradually merges into high terraces parallel with the rivers. In this gravel, principally towards its base, at a depth of 15 feet or more, numerous Palæolithic implements have been

found in the Bournemouth and Barton cliffs, but decalcification has destroyed all other fossils. The gravel seems to be derived mainly from the destruction of the higher series, and is therefore more rolled.

VALLEY GRAVEL.

The wide low-lying terrace bordering the Avon and Stour calls for little remark. This gravel consists mainly of flints, brought direct from the Chalk Downs, and is therefore less worn than the older series, from which it is separated by a sharp bluff. A mile or so from the river it may rise as much as 30 feet above the present flood-level, but its lower edge merges into or passes beneath the Alluvium. It may be compared with the 'Coombe Rock' of Brighton and Worthing, and, like that sheet, was probably formed towards the close of the Glacial Period, by rain falling on Chalk Downs rendered impervious by freezing. Thus violent floods were caused, which swept rough gravel over flats where now only alluvial mud is deposited. This process takes place every spring in Canada.

PEAT.

The peat mosses in this area are but small, though thin peat and peaty soil are common over the Bagshot Sands. At the base of the peat near Bournemouth Pier, and in Luscombe Valley at the Poole Waterworks, numerous pine trees were found. On steep slopes of sand south of Poole Harbour the roots of heather and bilberry form a matted fibrous peat, which though only a few inches thick is extensively dug for growing orchids. Its exceptional value is probably due to the perfect washing and aeration it has undergone on these steep sandy slopes.

ALLUVIUM.

The extensive alluvial flats of the Avon, Stour and Frome, are partly of estuarine and partly of fluviatile origin. The rivers once ran far below their present level, and their valleys since then have been turned into estuaries and silted up except in the case of Poole and Christchurch Harbours. To what depth these old channels were excavated in Neolithic times is still unknown; though other valleys in the South of England are filled with over sixty feet of Alluvium.

BLOWN SAND.

Sand dunes in places forty feet in height nearly cross the entrance to Poole Harbour, and during on-shore gales sand is piled on the top of Bournemouth cliff to a depth of twenty feet. Besides these modern dunes there are also traces of more ancient wind-blown sand over the open moors, especially over the Plateau Gravel on the exposed scarp above Parkstone.

ECONOMICS AND WATER SUPPLY.

The agricultural character of the country has been alluded to incidentally in previous sections. This is essentially an area of barren sandy heaths, with clumps of wood or scattered pines; but the wildness and the open unenclosed character give a charm to Bournemouth and to Poole Harbour, and make the neighbourhood desirable for residential purposes. The rapid increase of building has led necessarily to a considerable demand for bricks, which are made from various local brickearths; but, now that the Hengistbury ironstone is no longer worked, the only other mineral of economic importance is the white pipe-clay shipped at Poole.

Water is usually obtained from the gravels or from the Bagshot Beds; but in each case it is very ferruginous, and the gravel supply is always liable to contamination owing to the loose character of the stratum. Bournemouth is about to increase and better its supply from wells in the Chalk north of Wimborne, where water of unexceptional character can be found beneath impervious Eocene strata. The subjoined analysis by Professor Attfield of the water obtained from a similar well at the South Western Mineral Water Works in Wimborne, indicates that the water is very pure, but, like all Chalk waters, is somewhat hard:—

	Grains per gallon.
Total suspended solid matter - - - -	none.
Total dissolved solid matter - - - -	28·0
Ammoniacal matter, yielding ten per cent. of nitrogen (equal to ammonia per million, 0·07)	0·04
Albuminoid organic matter, yielding ten per cent. of nitrogen (equal to ammonia per million, 0·02) - - - -	0·01
Nitrites - - - -	none.
Nitrates, containing seventeen per cent. of nitrogen (equal to grains of nitrogen per gallon, 0·05) - - - -	0·3
Chlorides, containing sixty per cent. of chlorine (equal to grains of chlorine per gallon, 2·5) -	4·2
Hardness, reckoned as chalk-grains or "degrees":	
removed by ebullition ("temporary")	14°
unaffected by ebullition ("permanent")	6°
Total hardness - - - -	20°
Lead or copper - - - -	none.
Physical examination - - - -	satisfactory
Oxygen absorbed in 3 hours - - - -	0·01

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